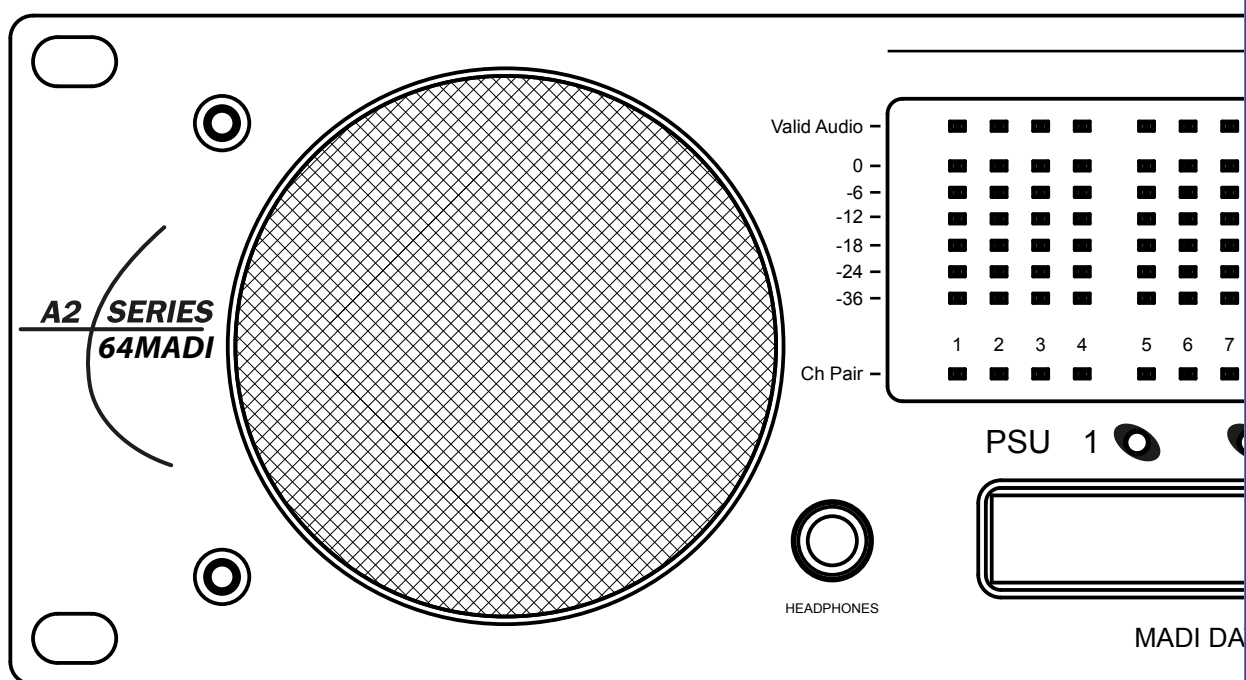


BM-A2-64MADI

MADI Audio and Status Monitor



Installation and User Guide

Reference To Statement Of Conformity

This document confirms that products bearing the CE label meet all the requirements in the EMC directive 2004/108/EC and LV directive 2006/95/EC laid down by the Member States Council for adjustment of legal requirements. Furthermore the products comply with the rules and regulations from 30 August 1995 referring to the electromagnetic compatibility of devices. Bel Digital Group BM-A2-64MADI units bearing the CE label comply with the following harmonised or national standards:

EMC:

BS EN 55103-1 :2009

BS EN 55103-2 :2009

Safety:

BS EN 60950-1: 2006 (ed. 2) + A1:2010

Insulation:

Class1



Instructions for Disposal of WEEE by Users in the European Union

The symbol shown here is on the product or on its packaging, which indicates that this product must not be disposed of with other waste. Instead, it is the user's responsibility to dispose of their waste equipment by handing it over to a designated collection point for recycling of waste electrical and electronic equipment.

The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service or where you purchased the product.

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The information contained in this manual has been carefully checked for accuracy; however no guarantee is given with respect to its correctness. Bel Digital Group Ltd. accepts no responsibility or liability for any errors or inaccuracies that may appear in this manual or the products and software described in it. Specifications and information contained in this manual are subject to change at any time without notice.

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This appliance has a serial number located on the rear panel. Please record the serial number here for your records.

Model Number.....BM-A2-64MADI

Serial Number.....

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Important Safety Instructions

1. Read these instructions
2. Keep these instructions
3. Heed all warnings
4. Follow all instructions
5. Do not use this apparatus near water
6. Do not expose this apparatus to rain or moisture.
7. Clean only with a dry cloth
8. Do not block any ventilation openings. Install with accordance with the manufacturer's instructions.
9. No naked flames, such as lighted candles, should be placed on the apparatus.
10. Do not install near any heat sources such as radiators, heat registers, stoves or other apparatus (including amplifiers) that produce heat.
11. There are no user-adjustments, or user-servicable items, inside this apparatus. Do not remove the covers of this apparatus; doing so will invalidate your warranty.
12. Adjustments or alterations to this apparatus may affect the performance such that safety and/or international compliance standards may no longer be met.
13. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally or has been dropped.

Caution

14. Hazardous voltages may be present inside this apparatus.
15. Do not operate this apparatus with the covers removed.
16. To reduce the risk of electric shock, do not perform any servicing other than that contained in these Installation Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel and ensure that all power cords are disconnected when servicing this apparatus.
17. Only use attachments/accessories specified by the manufacturer.

Power Safety

18. This apparatus is fitted with a universal power supply, approved and certified for operation in this apparatus. There are no user-replaceable fuses.
19. An external over-current protection device is required to protect the wiring to this apparatus. This protection device must be installed according to current wiring regulations. In certain countries this function is supplied by use of a fused plug.
20. If an extension power cable or adaptor is used, ensure that the total power rating of the power cable and/or adaptor is not exceeded.
21. An external disconnect device is required for this apparatus; a detachable power cord is a suitable disconnect device.
22. The apparatus should be located close enough to an AC outlet so that you can easily grasp the power cord plug at any time.
23. This apparatus is a Class I construction and shall be connected to an AC outlet with a protective grounding connection.
24. Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
25. Unplug this apparatus during lightning storms or when unused for long periods of time.
26. All power cords must be disconnected to isolate this apparatus completely.
27. Caution: To reduce the risk of electric shock, plug each power supply cord into separate branch circuits employing separate service grounds
28. This equipment is not supplied with a detachable power cord. The device should be connected to a power supply only of the type described in the Installation Guide or as marked on the device. The power cord must be earthed and precautions should be made so that the grounding is not defeated. A mains cord, fitted with an IEC 60320 C13 type socket, appropriate sized conductors and plug to suit local electrical requirements.
29. The power supply cord (i.e. conductor, coupler (IEC60320 C13) and plug combination) must be suitably rated for apparatus and the country of use (meeting local electrical requirements). A power supply cord with a rating of not less than 125% of current rating is suitable. The minimum rating for the power supply cord at 110 / 230V ac to be 1A.

Installation

30. When installing this apparatus, either fix it into a standard 19" rack or place the apparatus on a secure level surface. When this apparatus is rack mounted, fit all rack screws.
31. Ensure that no strain is placed on the cables connecting to this apparatus. Ensure also that such cables are not placed where they can be stepped on, pulled or tripped over.
32. Do not operate this apparatus whilst it is covered or boxed in any way.

Important Safety Precautions



CAUTION: TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT REMOVE COVER (OR BACK). NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL

CAUTION: RISK OF ELECTRIC SHOCK. THIS EQUIPMENT HAS MORE THAN ONE POWER CORD. TO REDUCE THE RISKS OF ELECTRIC SHOCK DISCONNECT BOTH POWER SUPPLY CORDS BEFORE SERVICING



The lightning flash with arrowhead symbol, within equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating instructions and maintenance (servicing) instructions in the literature accompanying the appliance.

Important Safety Information

This apparatus has no mains switch or other user-operated control for disconnecting the AC mains power. The mains plugs or the appliance couplers (IEC sockets) are used as the disconnect devices. Either device must remain readily operable and accessible when the apparatus is installed for use.

This unit includes thermally resettable fuses that are integral to the power supply circuitry, but the unit must always be powered from a supply fitted with an HRC type (High In-Rush Current) fuse with a rating of 1 A.

Warning: Excessive sound pressure levels from headphones can cause hearing loss.

Thank you for buying this Bel Digital Group product. The BM-A2-64MADI MADI Audio and Status Monitor is designed to provide a unique method of reliably monitoring audio and metadata in MADI streams of up to 64 channels operating at sample rates up to 96 kHz. In addition, the BM-A2-64MADI's comprehensive facilities enable the conversion from a complete MADI stream to both balanced and unbalanced AES formats.

The BM-A2-64MADI is a very high quality product, engineered for maximum reliability in professional broadcast, live and production environments. It requires virtually no configuration on installation, or adjustment in normal use.

This manual covers the BM-A2-64MADI's connections and indications, including its various options for monitoring and synchronisation. Please keep the manual in a safe place once you have installed the unit.

Important – Please do take the time to register your BM-A2-64MADI with Bel Digital Group Ltd., by emailing us the unit's serial number and your contact details to info@beldigital.com. Thank you.

Environment – The BM-A2-64MADI's range of operating temperature and relative humidity (RH) are as follows:

Temperature: 5°C to 40°C

RH: Operating 20 to 80%

What's In The Box

Unpacking

Unpack the BM-A2-64MADI with care. It is always a good idea to store all packaging (if practical), in case you ever need to return the unit to Bel for any reason.

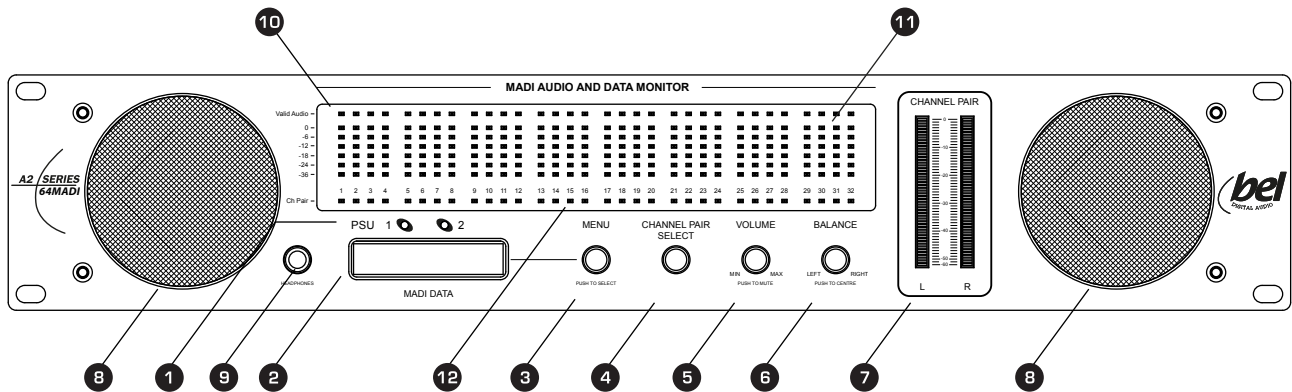
The shipping carton should contain the items listed below. Please contact your distributor immediately if any of them are missing or damaged.

- BM-A2-64MADI
- Instruction manual
- 2 x IEC connector retaining clamp

BM-A2-64MADI Main Features

- 64 channel audio monitoring, plus metering
- Single or two channel monitoring options
- Operates with sample rates from 44.1 kHz to 96 kHz
- Supports high speed and SMUX protocols
- Comprehensive MADI status monitor
- Converts all MADI channels to balanced (AES/EBU) and unbalanced (AES3-id) outputs
- Can convert from SMUX MADI to high speed AES
- MADI input available as both copper (BNC) and optical (SC)
- MADI loop-through, plus fibre to coax or coax to fibre conversion
- MADI output conforms to AES10id-2008; AES3 output to AES3-1992
- Transparent to Dolby® D/E (with SRC OFF)
- Switchable sample rate conversion (SRC) on all inputs to resync to local house clock (maintaining same sample frequency)
- Sync to external wordclock, external AES3, video black-and-burst or MADI
- Sync reference outputs in wordclock and AES3 formats
- Two independent PSUs with separate IEC inputs for redundancy

Front Panel Description



1 PSU status – two bi-colour LEDs confirming the current status of each PSU. The LEDs are green in normal operation and flash red if a PSU fault condition is detected.

2 MADI Data display – a 2x16 character LCD providing interrogation of embedded information such as MADI frame data, AES channel status bits and audio data; plus the provision of menu features for unit configuration.

3 Menu control – Rotary encoder with push action to navigate through the MADI Data display.

4 Channel Pair Select – Rotary encoder with push action to navigate across all 32 AES channel pairs. The selected channel pair is indicated by LED (12) illuminating under the selected channel pair number. Pushing the encoder will return selection to the first channel pair.

5 Volume – Rotary encoder with push action to control front panel speaker and headphone volume. It also controls the analogue line level outputs on the rear panel [13] and [14]. Pushing the encoder will mute the speakers and outputs.

6 Balance – Rotary encoder with push action to control the monitor balance of the selected channel pair. Pressing the encoder will centre the audio output.

7 Channel Pair L R meters – Hi-resolution (52 segment) tri-colour LED bargraph meters with peak hold. Meters follow the Channel Pair Select control [4].

8 Speakers – Two high quality/high output full-range speakers, to present the selected audio pair using the Channel Pair Select control [4].

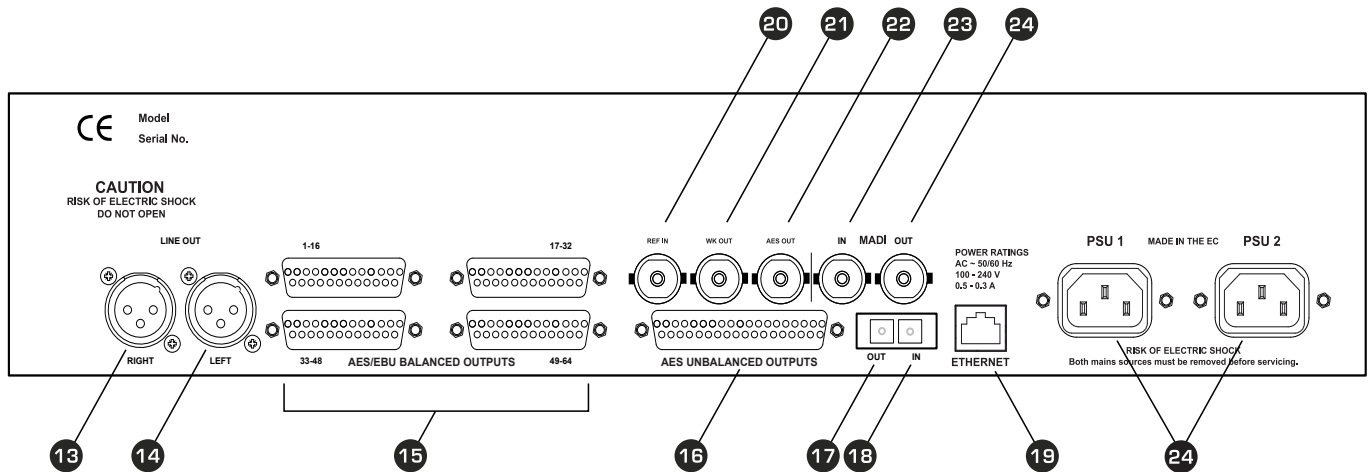
9 Headphone – Headphone output (¼" TRS output jack) with speaker mute facility.

10 Valid Audio – Green LED indicates the presence of a valid AES channel pair as determined by the presence of a valid audio flag in the channel status bits.

11 AES pair bargraphs – Six segment bargraph meters indicating presence of audio in the channel pair (each bargraph represents two channels - L and R)

12 Channel pair – Blue LED indicates the selected channel(s) for monitoring.

Rear Panel Description



- 13 RIGHT** – Line output (XLR) which carries the same audio as the right speaker (fixed level).
- 14 LEFT** – Line output (XLR) which carries the same audio as the left speaker (fixed level).
- 15 AES/EBU BALANCED OUTPUTS** – Four 25-way female Dsub ports wired to Tascam format. Providing balanced AES outputs of all the available MADI channels.
- 16 AES UNBALANCED OUTPUTS** – 37-way female Dsub connector providing unbalanced AES3-id outputs of all available MADI channels.
- 17 OUT** – Optical MADI output (SC connector)
- 18 IN** – Optical MADI input (SC connector)
- 19 ETHERNET** – Ethernet port (RJ45)
- 20 REF IN** – External synchronisation reference input (BNC).
- 21 WK OUT** – Derived wordclock output from selected reference input (BNC).
- 22 AES OUT** – Derived AES3 sync output from selected reference input (BNC).
- 23 IN** – Coaxial MADI input (BNC)
- 24 OUT** – Coaxial MADI output (BNC)
- 25 PSU** – AC inputs, 2 x IEC sockets.

Hardware Considerations

The BM-A2-64MADI is built in a 2U 19" enclosure. It is intended to be permanently installed in a standard 19" equipment rack. There are ventilation grilles in the top, bottom and both sides of the enclosure, and care must be taken to ensure that these are not blocked by cables or other equipment when the unit is installed. Do not install any other items of equipment immediately above or below to the BM-A2-64MADI; the use of 1U blanking panels is recommended.

Power Supply Considerations

The BM-A2-64MADI is fitted with two separate, auto-ranging switch-mode power supplies (PSUs). The operating voltage range is 100 to 240 V AC, 50/60 Hz. The internal power rails are diode-paralleled to the two supplies, and the unit will operate normally if only one PSU is powered or functional. For maximum protection when using both PSUs, the two AC inlet cables should be connected to mains circuits which are as independent of each other as possible.

If redundant operation is not required, only one AC supply cable need be connected; either AC inlet may be used.

Fuses And Ratings

Each of the BM-A2-64MADI's PSUs has an internal resettable fuse for PSU protection. These fuses are not accessible to the user. The unit should be powered from a mains supply (supplies) fitted with an external HRC-type fuse (High Inrush Current) rated at 1 A.

Unit Connections

MADI Inputs and Outputs

The BM-A2-64MADI can simultaneously monitor and convert up to 64 audio channels embedded in the MADI stream and provide them as both AES/EBU and AES3-id outputs.

MADI inputs are provided as fibre on an SC type connector (multi-mode) and coaxial (on BNC). The characteristic impedance of the coaxial input is 75 ohms.

The selected MADI source is also available as both fibre and coaxial outputs to simplify the connection of further equipment. The co-axial MADI output is on a BNC socket, and is compliant with AES10id-2008. The characteristic impedance is 75 ohms, at a nominal data rate of 125Mbps. Transmission distances up to 50 m are generally achievable. The fibre loop-through output is provided on an SC type connector. Recommended fibre types are 62.5/125 µm or 50/125 µm, multi-mode. Transmission distances of at least 1000 m are achievable.

Note: A single-mode fibre option is available, but only at time of order.

AES/EBU Outputs

The 64 audio channels converted from the MADI input are available as 32 AES/EBU digital audio output pairs on four rear panel 25-way female Dsub connectors [15]. Appropriate channel numbers are screenprinted on the rear panel adjacent to each connector. The outputs are balanced and are compliant with AES3-1992. The diagram below provides the pinout (which is Tascam digital compatible):

CHANNEL PAIR	PIN	OUTPUT
n+1	25	Gnd
	12	Cold
	24	Hot
n+2	11	Gnd
	23	Cold
	10	Hot
n+3	22	Gnd
	9	Cold
	21	Hot
n+4	8	Gnd
	20	Cold
	7	Hot
n+5	19	Gnd
	6	Cold
	18	Hot
n+6	5	Gnd
	17	Cold
	4	Hot
n+7	16	Gnd
	3	Cold
	15	Hot
n+8	2	Gnd
	14	Cold
	1	Hot

$n=0, 8, 16, 24$

To aid installation, an optional AES/EBU breakout panel (BOB/O-32) is available from Bel. This consists of a 1U 19" panel with 16 XLR3M connectors fitted (32 channels).

AES3-id Outputs

The 64 audio channels converted from the MADI input are also available as 32 AES3 digital audio outputs on the rear panel 37-way female Dsub connector [16]. The outputs are unbalanced (AES3-id), but are compliant with AES3-1992 in all other respects. The table below provides the pinout:

PIN	OUTPUT	AUDIO CHANNELS
1	AES 1	Chs 1 & 2
2	AES 2	Chs 3 & 4
3	AES 5	Chs 9 & 10
4	AES 6	Chs 11 & 12
5	AES 9	Chs 1 & 2
6	AES10	Chs 3 & 4
7	AES 13	Chs 9 & 10
8	AES 14	Chs 11 & 12
9	AES 17	Chs 1 & 2
10	AES 18	Chs 3 & 4
11	AES 21	Chs 9 & 10
12	AES 22	Chs 11 & 12
13	AES 25	Chs 1 & 2
14	AES 26	Chs 3 & 4
15	AES 29	Chs 9 & 10
16	AES 30	Chs 11 & 12
17	n/c	
18	n/c	
19	GND	
20	AES 3	Chs 5 & 6
21	AES 4	Chs 7 & 8
22	AES 7	Chs 13 & 14
23	AES 8	Chs 15 & 16
24	AES 11	Chs 5 & 6
25	AES 12	Chs 7 & 8
26	AES 15	Chs 13 & 14
27	AES 16	Chs 15 & 16
28	AES 19	Chs 5 & 6
29	AES 20	Chs 7 & 8
30	AES 23	Chs 13 & 14
31	AES 24	Chs 15 & 16
32	AES 27	Chs 5 & 6
33	AES 28	Chs 7 & 8
34	AES 31	Chs 13 & 14
35	AES 32	Chs 15 & 16
36	n/c	
37	GND	

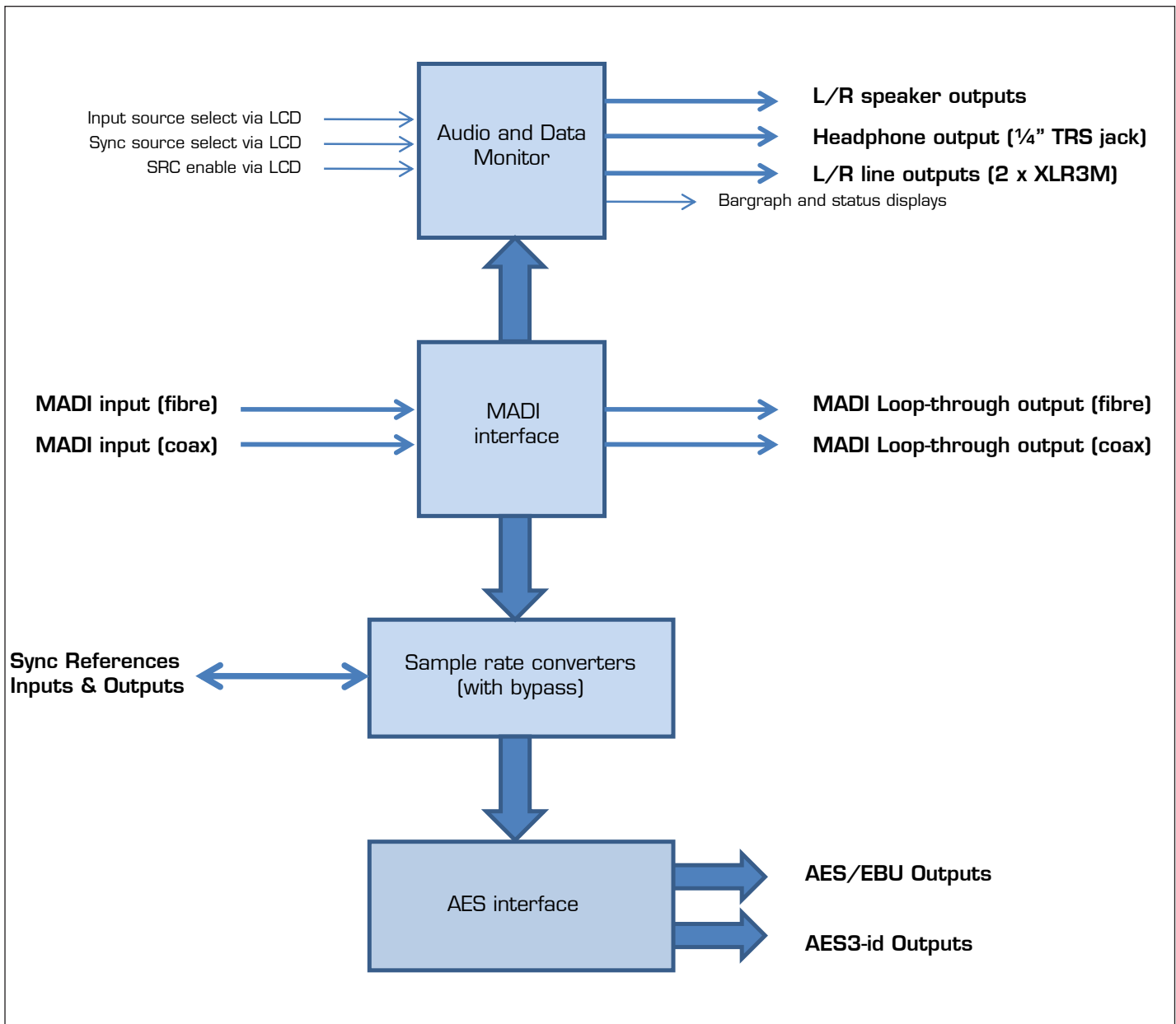
Note that each AES3 output carries 2 audio channels.

To aid installation, an optional AES3-id Signal Break Out panel (ASBO) is available from Bel. This consists of a 1U 19" panel with 32 BNC sockets, prewired to a 37-way Dsub plug. This may be mounted at the front or rear of the rack and greatly simplifies wiring.

ETHERNET Port

The BM-A2-64MADI includes a standard RJ45 Ethernet port (19). This functionality is for firmware updates.

Block Diagram



Front Panel Operation

The BM-A2-64MADI provides a very intuitive front panel interface that allows the user to view and monitor all available incoming MADI channels either as channel pairs or mono channels.

A MADI stream essentially consists of multiple AES channel pairs (up to 32) being serially transmitted from one device to another. The BM-A2-64MADI intercepts these AES pairs and presents them on the front panel as 32 channel pair bargraph meters [11]. It is then possible to view at a glance, the audio levels of all AES pairs present within the incoming MADI stream.

Note: each channel pair bargraph meter is a monosum of its left and right channels.

Selecting a channel to monitor

Use the CHANNEL PAIR SELECT rotary encoder [4] to monitor any of the available channel pairs or individual channels on the BM-A2-64MADI (see "MONO mode selection" on page 15 to find out how to select between monitoring channel pairs and individual channels). By turning the encoder the blue channel pair select LED [12] will scroll across the channel pair bargraphs to indicate which pair is currently selected. When the required channel pair or channel is selected, it is routed to the hi-resolution bargraph meters [7], speakers [8], headphone output [9] and the rear panel mounted line level outputs [13] and [14].

Tip: Pressing the CHANNEL PAIR SELECT encoder returns selection directly to channel 1 or channel pair 1 (depending on the monitoring mode selected). Thus bypassing the need to scroll all the way back down to channel 1.

Volume Control

Rotate the VOLUME encoder [5] to alter the level applied to the front panel speakers and headphone output. To mute the outputs, press the encoder. Mute indication is provided by the letter **M** being visible on the MADI Data display [2] when in the Main Configuration Display page; see page 13. To unmute the audio, press the encoder again.



MADI Data display (default) - Mute Off



MADI Data display (default) - Mute On

Balance Control

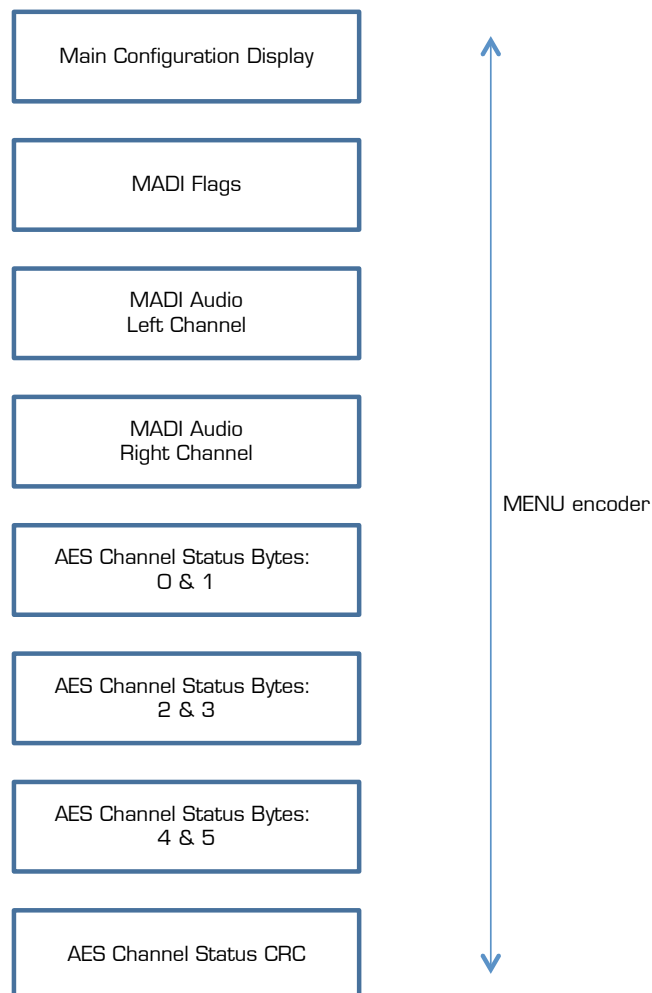
The BALANCE control [6] differentially adjusts the level of the speaker, headphone and line outputs. Pressing the encoder will centre the audio output.

Using the MENU encoder

The MADI Data display provides two functions:

- Unit Configuration
- MADI data interrogation

These functions are accessed by use of the MENU encoder [3]. Rotating the encoder will scroll through the top level menu.



The first page of the menu is the Main Configuration Display. It is from here that you configure the BM-A2-64MADI settings such as sync source, sample rate converters, MADI input, Monitoring mode etc. Subsequent pages are all concerned with the channel pair that is currently selected. These remaining seven pages provide specific audio data relating to the selected channel pair.

The following section details the available menu pages.

Main Configuration Display

Use this page to configure the BM-A2-64MADI to interface with your existing audio system.

MAD Sync F 48.00
SRCoff Opto in

Main Configuration Display

All settings can be altered by use of the MENU encoder. To make changes first press the MENU encoder. An < icon will appear on the display and this points to the parameter that can be changed.

Synchronisation

The BM-A2-64MADI should normally be used as a slave device, synchronised to an external clock reference. BM-A2-64MADI offers a choice of synchronisation sources. The selected source is also used as reference for sample rate converters (if enabled), thus ALL audio outputs, both in AES/EBU and AES3-id formats, will be locked to the selected reference.

With the < icon pointing to **Sync** it is possible to change the synchronisation source.

MAD Sync<F 48.00
SRCoff Opto in

Rotate the MENU encoder to scroll through the available options:

MAD Sync - Synchronise to the incoming MADI

WK Sync - Synchronise to an external wordclock. The clock source should be connected to the REF IN connector [20] on the rear panel. Clock pulses should be of 5 V amplitude, positive-going.

VID Sync - Synchronise off Black-And-Burst. The BM-A2-64MADI can synchronise to a standard (SD) 1 V black-and-burst video signal. The video signal should be connected to the REF IN connector. The sync input auto-detects NTSC or PAL standard video. This should only be used with 48 kHz sample rate material.

AES Sync - An AES3-compliant digital audio source may be used as the clock reference source. Any audio data contained in the AES3 word will be ignored. The audio source should be compliant with AES3-id for 75 ohm coaxial transmission and connected to the REF IN connector.

Note: When selecting any sync source other than MADI, it may be necessary to enable the sample rate converters. See the following section for details on how to achieve this.

Note: A reference clock output is available at the rear panel WK OUT connector [20] and at the AES OUT connector [21]. These are derived from whichever synchronisation source is selected.

Note: Video sync also includes an internally generated 48 kHz clock if internal sync is required.

Synchronisation frequency display

The Main Configuration Display provides a real time readout of the current synchronisation frequency (e.g., F 48.00). This is a useful tool as it will highlight any incoming drift away from the default synchronisation frequency. The meter's source is determined by the sync source selected.

Sample Rate Converters (SRCs)

As with all operations involving digital audio, it will generally be desirable for the audio outputs of the BM-A2-64MADI to be synchronised (in frequency and/or phase) with a master reference clock, which will also synchronise all other digital audio devices in the facility. However, it may be that the incoming MADI stream requires re-synchronising to a different house clock - such as that in an outside broadcast vehicle for example.

To achieve this, BM-A2-64MADI includes a Sample Rate Converter (SRC) for each converted AES pair. The SRCs may be switched in or out from within the Main Configuration Display.

When enabled, the SRCs re-clock the audio data against the sync reference at the REF IN connector, ensuring that the word blocks in the data are phase-locked exactly to the reference clock. The BM-A2-64MADI allows the user to select a reference clock source to suit the infrastructure of the facility and the nature of the transfer process.

Note: Passing Dolby-encoded material through sample rate converters will corrupt the Dolby bitstream.

Press the Menu encoder again to move the pointer to the SRC section.

Note: This function is to synchronise the incoming MADI source to a local clock. The sample rate would remain the same.



MAD Sync F 48.00
SRCoff<Opto in

Rotate the encoder to select between:

SRCoff - Sample rate converters switched off

SRCOn - Sample rate converters switched on

MADI input source selection

BM-A2-64MADI is able to accept two independent MADI streams; one optical fibre and the other coaxial. Selection of these sources is controlled from the Main Configuration Display.

Press the Menu encoder again to move the pointer to the input section.



MAD Sync F 48.00
SRCoff Opto in<

Rotate the encoder to select between:

Opto in - Use the fibre SC MADI connectors

Coax in - Use the coax BNC MADI connectors

Once finished, press the MENU encoder again and the Main Configuration Display moves to the next screen.

MADI input mode selection

The BM-A2-64MADI is capable of automatically sensing the incoming sample frequency from 44.1 kHz to 96 kHz. There are also two recognised protocols used for the transmission of 88.2 kHz and 96 kHz material. These are known as 'High Speed' and the historic SMUX protocols. The BM-A2-64MADI is capable of working with both.

In automatic mode the BM-A2-64MADI will detect the more recent 88.2 and 96 kHz high speed protocol.

If receiving the legacy SMUX protocol then rotate the encoder to select SMUX.



MADI Mode AUTO<

Rotate the encoder to select between:

Auto - Auto detect sample rates from
44.1 kHz to 96 kHz (High Speed)

SMUX - Select this when receiving
88.2 kHz or 96 kHz sources using the
SMUX protocol

Note: When in SMUX MADI mode, the BM-A2-64MADI can be used to convert from incoming SMUX to High Speed format at the AES outputs.

Once finished, press the MENU encoder again and the Main Configuration Display moves to the next screen.

MONO mode selection

Two monitoring modes are available on the BM-A2-64MADI - two channel and mono. The selection of either of these modes depends on the application.

- 2-CH enables monitoring of the selected AES pair through the speakers as a stereo (or two channel) source. Rotating the Channel Pair Select encoder enables the user to scroll through and monitor each of the AES channel pairs (1 to 32) in turn.
- MONO changes the monitoring mode to single channel selection. Turning the same encoder now only increments the channel count by 1, enabling individual channels within the MADI stream to be monitored. The display indicates which channel is currently selected for monitoring.



MONO Mode MONO<
Channel 1

Rotate the encoder to select between:

2-CH - listen to an AES pair within the MADI stream

MONO - monitor individual channels

Press the MENU encoder to return to the main display window.

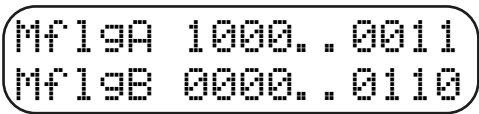
MADI Flags

Each audio channel within a MADI stream consists of 32 bits. Audio (or non-audio data) accounts for 24 bits, with the remaining being used to identify the state of the MADI stream and to preserve the original AES format. It is these remaining bits that are referred to as the MADI flags.

Of the eight data bits, four precede the audio data (the least significant bits) and four follow after the audio data (the most significant bits).

See below for details of each MADI flag.

The BM-A2-64MADI provides a MADI Flag page in the MADI Data display. Rotate the MENU encoder to scroll to the MADI Flag page.



Example MADI Flag page

The display indicates both the left (A) and right (B) channels of the selected channel pair.

The bits increment from right to left. So Bit 0 is on the right and bit 31 is on the left. Audio data is represented by the two dots in the middle of the data sequence. Audio data can be interrogated in MADI Audio data pages.

MSB

313029282726252423222120191817161514131211109876543210

LSB

Audio data

0

MADI frame synchronisation bit: When set to 1, this indicates the start of a MADI stream (i.e., ch1)

1

MADI channel active: When set to 1, this indicates an active channel in the MADI stream.

2

AES3 subframe A/B: Distinguishes between Left (0) and Right (1) channels of a channel pair.

3

AES3 Channel Status block start: A value of 1 indicates the first frame of the AES3 block.

28

AES3 Validity: A value of 0 indicates that valid audio is present.

29

AES3 User bit: This value is determined by the transmission device.

30

AES3 Channel Status bit: The value of this bit can be interrogated in the Channel Status displays.

31

AES3 Parity bit: Parity bit for error correction purposes.

MADI Audio data

Audio data within a MADI stream can be 16, 20 or 24 bit. By using the MADI Audio display it is very easy to determine the selected channel pair's audio bit length. If audio is present then the display will show rapidly changing values, however it will be very easy to notice that there will be either four (for 20 bit) or eight (for 16 bit) static zeros in the display.

```
A1H 000010111101
A1L 010011101101
```

MADI Audio data (24 bit)

```
A1H 000010111101
A1L 010011110000
```

MADI Audio data (20 bit)

```
A1H 000010111101
A1L 011100000000
```

MADI Audio data (16 bit)

Within the display, A1L contains the lower 12 bits of the audio and A1H contains the upper 12 bits.

There are two MADI Audio pages for the selected channel pair. The first, A1H and A1L, represents the left channel and the second page, A2H and A2L, represents the right channel.

Use the MENU encoder [2] to scroll between these pages.

AES Channel Status Bytes

Six of the most commonly used Channel Status bytes can be viewed on the BM-A2-64MADI, plus the Channel Status Check Sum.

Use the MENU encoder [2] to scroll through these pages.

```
CS0 10000001
CS1 00000000
```

Channel Status Byte 0 and 1

```
CS2 00000000
CS3 00000000
```

Channel Status Byte 2 and 3

```
CS4 00000000
CS5 00000000
```

Channel Status Byte 4 and 5

```
CRC 9B
```

Channel Status Byte Check Sum

An overview for each of the Channel Status Bytes above can be found in the Appendix.

The following Channel Status tables provide an overview of the Channel Status Byte data that the BM-A2-64MADI can display. Various notes and considerations must be applied to each Channel Status Byte and such information is beyond the scope of this user manual. Such information is readily available and can also be purchased directly from the AES website (www.aes.org).

AES3-2-2009: AES standard for digital audio - Digital input-output interfacing - Serial transmission format for two-channel linearly-represented digital audio data - Part 2: Metadata and Subcode

Channel Status Byte 0: Basic Audio Parameters

BIT	0	USE OF CHANNEL STATUS BLOCK
State	0	Consumer use of channel status block.
	1	Professional use of channel status block.

BIT	1	LINEAR PCM IDENTIFICATION
State	0	Audio sample word represents linear PCM samples.
	1	Audio sample word used for purposes other than linear PCM samples.

BITS	4 3 2	AUDIO SIGNAL EMPHASIS
States	0 0 0	Emphasis not indicated. Receiver defaults to no emphasis with manual override enabled.
	0 0 1	No emphasis. Receiver manual override is disabled.
	0 1 1	50 μ s + 15 μ s emphasis, see ITU-R BS.450. Receiver manual override is disabled.
	1 1 1	ITU-T J.17 emphasis (with 6,5-dB insertion loss at 800 Hz). Receiver manual override is disabled
	All other states of bits 2 to 4 are reserved and are not to be used until further defined.	

BIT	5	LOCK INDICATION
State	0	Default. Lock condition not indicated.
	1	Source sampling frequency unlocked.

BITS	7 6	SAMPLING FREQUENCY
States	0 0	Sampling frequency not indicated. Receiver default to interface frame rate and manual override or auto set is enabled.
	1 0	48 kHz sampling frequency. Manual override or auto set is disabled.
	0 1	44.1 kHz sampling frequency. Manual override or auto set is disabled.
	1 1	32 kHz sampling frequency. Manual override or auto set is disabled.

Note: Please refer to the AES standard for digital audio — Digital input-output interfacing — Serial transmission format for two-channel linearly represented digital audio data Part 2: Metadata and Subcode (AES3-2-2009), for full details concerning Channel Status implementation.

Channel Status Byte 1:

User Bits Management

BITS	3 2 1 0	CHANNEL MODE
States	0 0 0 0	Mode not indicated. Receiver default to two-channel mode. Manual override is enabled.
	1 0 0 0	Two-channel mode. Manual override is disabled.
	0 1 0 0	Single-channel mode (monophonic). Manual override is disabled.
	1 1 0 0	Primary-secondary mode, subframe 1 is primary. Manual override is disabled.
	0 0 1 0	Stereophonic mode, channel 1 is left channel. Manual override is disabled.
	1 0 1 0	Reserved for user-defined applications.
	0 1 1 0	Reserved for user-defined applications.
	1 1 1 0	Single channel double sampling frequency mode. Sub-frames 1 and 2 carry successive samples of the same signal. The sampling frequency of the signal is double the frame rate, and is double the sampling frequency indicated in byte 0, but not double the rate indicated in byte 4, if that is used. Manual override is disabled. Vector to byte 3 for channel identification.
	0 0 0 1	Single channel double sampling frequency mode – stereo mode left. Subframes 1 and 2 carry successive samples of the same signal. The sampling frequency of the signal is double the frame rate, and is double the sampling frequency indicated in byte 0, but not double the rate indicated in byte 4, if that is used. Manual override is disabled.
	1 0 0 1	Single channel double sampling frequency mode – stereo mode right. Subframes 1 and 2 carry successive samples of the same signal. The sampling frequency of the signal is double the frame rate, and is double the sampling frequency indicated in byte 0, but not double the rate indicated in byte 4, if that is used. Manual override is disabled.
	1 1 1 1	Multichannel mode. Vector to byte 3 for channel identification.
All other states of bits 0 to 3 are reserved and are not to be used until further defined.		

BITS	7 6 5 4	USER BITS MANAGEMENT
States	0 0 0 0	Default, no user information is indicated.
	1 0 0 0	192-bit block structure with user-defined content. Block start aligned with Channel Status block start.
	0 1 0 0	Reserved for the AES18 standard.
	1 1 0 0	User defined.
	0 0 1 0	User data conforms to the general user data format defined in IEC 60958-3.
	1 0 1 0	192-bit block structure as specified in AES52. Block start aligned with Channel Status block start.
	0 1 1 0	Reserved for IEC 62537
	All other states of bits 4 to 7 are reserved and are not to be used until further defined.	

Note: Please refer to the AES standard for digital audio — Digital input-output interfacing — Serial transmission format for two-channel linearly represented digital audio data Part 2: Metadata and Subcode (AES3-2-2009), for full details concerning Channel Status implementation.

Channel Status Byte 2:

Auxiliary Bits, Word Length and Alignment Level

BITS	2 1 0	USE OF AUXILIARY BITS
States	0 0 0	Maximum audio sample word length is 20 bits (default). Use of auxiliary bits not defined.
	1 0 0	Maximum audio sample word length is 24 bits. Auxiliary bits are used for main audio sample data.
	0 1 0	Maximum audio sample word length is 20 bits. Auxiliary bits in this channel are used to carry a single coordination signal.
	1 1 0	Reserved for user defined applications.
	All other states of bits 0 to 2 are reserved and are not to be used until further defined.	

BITS	5 4 3	ENCODED AUDIO SAMPLE WORD LENGTH OF TRANSMITTED SIGNAL	
		Audio sample word length if maximum length is 24 bits as indicated by bits 0 to 2 above.	Audio sample word length if maximum length is 20 bits as indicated by bits 0 to 2 above.
States	0 0 0	Word length not indicated (default).	Word length not indicated (default).
	1 0 0	23 bits	19 bits
	0 1 0	22 bits	18 bits
	1 1 0	21 bits	17 bits
	0 0 1	20 bits	16 bits
	1 0 1	24 bits	20 bits
	All other states of bits 3 to 5 are reserved and are not to be used until further defined.		

BITS	7 6	INDICATION OF ALIGNMENT LEVEL
States	0 0	Alignment level not indicated.
	1 0	Alignment to SMPTE RP155, alignment level is 20 dB below maximum code.
	0 1	Alignment to EBU R68, alignment level is 18,06 dB below maximum code.
	1 1	Reserved for future use.

Note: Please refer to the AES standard for digital audio — Digital input-output interfacing — Serial transmission format for two-channel linearly represented digital audio data Part 2: Metadata and Subcode (AES3-2-2009), for full details concerning Channel Status implementation.

Channel Status Byte 3:

Multichannel Modes

BIT	7	MULTICHANNEL MODE
State	0	Undefined multichannel mode (default).
	1	Defined multichannel modes.

The definition of the remaining bit states depends on the state of bit 7.

Either:

BITS	6 TO 0	CHANNEL NUMBER, WHEN BYTE 3 BIT 7 IS 0
Value	The channel number is the numeric value of the byte, plus one, with bit 0 as the least significant bit.	

Or:

BITS	6 5 4	MULTICHANNEL MODE, WHEN BYTE 3 BIT 7 IS 1
States	0 0 0	Multichannel mode 0. The channel number is defined by bits 3 to 0 of this byte.
	0 0 1	Multichannel mode 1. The channel number is defined by bits 3 to 0 of this byte.
	0 1 0	Multichannel mode 2. The channel number is defined by bits 3 to 0 of this byte.
	0 1 1	Multichannel mode 3. The channel number is defined by bits 3 to 0 of this byte.
	1 1 1	User-defined multichannel mode. The channel number is defined by bits 3 to 0 of this byte.
	All other states of bits 4 to 6 are reserved and are not to be used until further defined.	

BITS	3 TO 0	CHANNEL NUMBER, WHEN BYTE 3 BIT 7 IS 1
Value	The channel number is the numeric value of these four bits, plus one, with bit 0 as the least significant bit.	

Note: Please refer to the AES standard for digital audio — Digital input-output interfacing — Serial transmission format for two-channel linearly represented digital audio data Part 2: Metadata and Subcode (AES3-2-2009), for full details concerning Channel Status implementation.

Channel Status Byte 4:

DARS, Hidden Information, Multiple-rate Sampling Frequencies

BITS	1 0	DIGITAL AUDIO REFERENCE SIGNAL
States	0 0	Not a reference signal (default)
	0 1	Grade 1 reference signal – see AES11
	1 0	Grade 2 reference signal – see AES11
	1 1	Reserved and not to be used until further defined.

BIT	2	INFORMATION HIDDEN IN PCM SIGNAL
State	0	No indication (default).
	1	Audio sample word contains additional information in the least significant bits (see AES55).

BITS	6 5 4 3	SAMPLING FREQUENCY
States	0 0 0 0	Not indicated (default)
	0 0 0 1	24 kHz
	0 0 1 0	96 kHz
	0 0 1 1	192 kHz
	0 1 0 0	384 kHz
	0 1 0 1	Reserved
	0 1 1 0	Reserved
	0 1 1 1	Reserved
	1 0 0 0	Reserved for vectoring
	1 0 0 1	22.05 kHz
	1 0 1 0	88.2 kHz
	1 0 1 1	176.4 kHz
	1 1 0 0	352.8 kHz
	1 1 0 1	Reserved
	1 1 1 0	Reserved
	1 1 1 1	User defined

BIT	7	SAMPLING FREQUENCY SCALING FLAG
State	0	No scaling (default)
	1	Sampling frequency is 1/1,001 times that indicated by byte 4 bits 3 to 6, or by byte 0 bits 6 to 7.

Note: Please refer to the AES standard for digital audio — Digital input-output interfacing — Serial transmission format for two-channel linearly represented digital audio data Part 2: Metadata and Subcode (AES3-2-2009), for full details concerning Channel Status implementation.

Channel Status Byte 5:

DARS, Hidden Information, Multiple-rate Sampling Frequencies

BITS	7 TO 0	RESERVED
Value	Set to logic 0 until further defined	

Channel Status Byte 23:

CRC data

BITS	7 TO 0	CHANNEL STATUS DATA CYCLIC REDUNDANCY CHECK CHARACTER (CRCC)
Value	Generating polynomial is $G(x) = x^8 + x^4 + x^3 + x^2 + 1$. The CRCC conveys information to test valid reception of the entire channel status data block (bytes 0 to 22 inclusive). For serial implementations the initial condition of all ones should be used in generating the check bits with the LSB transmitted first. There is no default; this field shall always be coded with a correct CRCC.	

Note: Please refer to the AES standard for digital audio — Digital input-output interfacing — Serial transmission format for two-channel linearly represented digital audio data Part 2: Metadata and Subcode (AES3-2-2009), for full details concerning Channel Status implementation.

Technical Specifications

MADI	
Input	1 x SC socket multi-mode (single-mode option available) 1 x Coaxial 75Ω BNC
Loop-through output	1 x SC socket multi-mode (single-mode option available) 1 x Coaxial 75Ω BNC
Format	Up to 64 channels, compliant with AES10id-2008
Sample frequency	44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz
Higher frequency protocol	SMUX and High Speed (for 88.2 kHz and 96 kHz sample frequencies)
Data Rate	125 Mbps ±25ppm
AES OUTPUTS	
AES/EBU outputs*	4 x Dsub-25 female (TASCAM format) 110Ω balanced
AES3-id outputs*	1 x Dsub-37 female 75 ohms unbalanced
Sampling frequency	44.1 kHz to 96 kHz (SMUX and High Speed)
LINE OUTPUTS	
Line output	Copy of speaker outputs on 2 x XLR3M connectors (fixed level)
Noise+THD	-108 dB w.r.t. maximum output
Frequency response	20 Hz to 20 kHz ±1 dB
SPEAKER OUTPUTS	
Peak accoustic level (@2ft)	100 dB SPL
Shielding	Magnetic
Main amplifier Noise+THD	-80 dB w.r.t. maximum output
SYNCHRONISATION	
Sample Rate Conversion	SRC available for all channels, switchable
Sources	Word clock, AES, Video Black-and-Burst, MADI
Video Sync input	PAL/NTSC 50/60 Hz (SD)
Word clock input	44.1 kHz to 96 kHz, DC coupled, positive going pulses
Word clock output	Follows Word clock input, DC coupled, positive going pulses (derived from incoming reference signal)
AES input	44.1 kHz to 96 kHz
AES output	44.1 kHz to 96 kHz (derived from incoming reference signal)
POWER SUPPLY	
Type	2 x independent switch-mode regulated, auto-ranging
Inputs	2 x 90 to 264 V AC, 50/60 Hz
Power consumption	16 W
Connectors	2 x IEC with retaining clips
PHYSICAL	
Dimensions (w x d x h)	483 x 256 x 89 (mm) / 19" x 10" x 3.5" [1U]
Weight	6 kg / 14 lbs

* Breakout panels are available.

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Specifications and information contained in this manual are subject to change at any time without notice.

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